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ML Directorate develops grease recommended for C-5

by Timothy R. Anderl, Materials and Manufacturing Directorate

WRIGHT-PATTERSON AIR FORCE BASE, Ohio — A low-cost, multi-purpose grease developed by the Air Force Research Laboratory received a positive evaluation from Air Force maintainers following nearly 1,529 airframe hours, or 11 months of operation, on the C-5 aircraft.

Equipment specialists from Dover Air Force Base, Delaware, who evaluated the grease's performance during a rigorous inspection of the aircraft in December 2003, have recommended that the C-5 convert to the new moisture-resistant and high-load carrying grease pending review of an Interim Status Report and approval by the C-5 System Program Office.

In September 2002, two C-5 landing gears were greased with the multi-purpose grease, MIL-PRF-32014, and two landing gears, which were packed with the current grease, were identified as control gears. To date, the new grease has acquired 1,529.6 airframe hours, 351 total landings, 299 full-stop landings and 360 gear cycles.

"By incorporating the stable, low-cost, rust-inhibiting grease, the Air Force could solve several challenges related to wear, corrosion and rust in the landing gear assembly of the C-5 aircraft," said Ms. Lois J. Gschwender, an engineer from AFRL's Materials and Manufacturing Directorate's Nonstructural Materials Branch. "During testing conducted by the University of Dayton Research Institute on-site contractors at the directorate, the grease demonstrated water washout resistance, high-temperature and high-speed performance. During flight testing, the new grease has proven that it provides superior anti-wear and anti-rust performance and will provide a significant cost advantage due to reduced maintenance, part replacement and system failures."

According to Ms. Gschwender, the directorate first began working with grease companies to develop the multi-purpose grease in the late 1980s. The team, led by Mr. Ed Snyder, had a goal of finding a commercial source of grease to replace the mineral oil sodium soap thickened product used in cruise missile engines. The mineral oil product reacted negatively to air moisture and was bleeding out of bearings while in storage.

"Greases are used in military applications to improve and ensure the performance of moving parts," said Ms. Gschwender. "When compared to liquid lubricant systems, grease systems provide significant advantages in the design of a system. Greases are self-contained, which eliminates the need for pumps, tubing, heat exchangers and other extra hardware that increase the weight and design requirements of a system."

Because no appropriate greases were commercially available, and only a small volume of grease was required for the missiles,

A C-5 Galaxy takes off from an airfield at a deployed location. By incorporating the ML-developed grease on the C-5, the Air Force could solve several challenges related to wear, corrosion and rust in the landing gear assembly of the C-5 aircraft. (Air Force photo by Tech. Sgt. Justin D. Pyle)

ML researchers and contractors from AMOCO designed unique lubricating grease, which was ultimately assigned the MIL-PRF-32014 military specification. The rigorous performance requirements in the specification require the grease composition to include anti-oxidant, anti-wear, and anti-rust ingredients.

Following validation testing by several military agencies and by Williams Engine Company, the grease was adopted for the cruise missile with great success, said Ms. Gschwender. When the original supply of grease was used up, there was still no commercial supply available because the usage volume of grease for the cruise missile was very small. Again, AMOCO custom made and delivered the second batch of the lubricant to the Air Force in 1994.

Mr. David Marosok, a lead C-5 landing gear engineer at Ogden Air Logistics Center, Utah, approached AFRL to solve a dilemma resulting from the implementation of very expensive grease ($5,000 per gallon) that had been recommended by a contractor to solve corrosion and rust problems. This grease had in fact aggravated the problems, Ms. Gschwender said.

Following collaboration with AFRL, where participants analyzed wear and rusting challenges that plagued the landing gear of the C-5, ML researchers, including Ms. Gschwender, Mr. Snyder and Dr. Shashi Sharma, determined that a MIL-PRF-32014 qualified grease could offer improvements in the

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landing gear. "The C-5 landing gear is regularly exposed to moisture and rain, air, bacterial decontaminants, and other corrosion and wear encouraging phenomena, which at times causes significant problems for operators, and challenges for systems maintainers," Ms. Gschwender said. While AMOCO was unavailable to manufacture the grease, Nye Lubricants, a small business that specializes in specialty lubes, commercialized qualifying grease called Rheolube 374A.

AirBP also has a grease qualified to the MIL-PRF-32014 specification they call Aeroplex 3214. The two current suppliers were attracted to the potential larger volumes offered by use in the C-5 aircraft, Ms. Gschwender said. "MIL-PRF-32014 is expected to cost less than $100 per gallon and to provide the desired improvement in performance over both the original grease and the contractor recommended grease," she added.

In late November and early December 2003, experts at Dover's Equipment Maintenance Squadron, who provide maintenance to the C-5 fleet beyond normal flight line servicing, conducted an isochronal inspection of the C-5 aircraft where the ML-developed grease was in use. The parts were observed and grease samples were taken for analysis by ML personnel at their facilities at Wright Patterson Air Force Base.

After examining the parts, and showing maintenance specialists test coupons with differing greases to demonstrate how they perform, aircraft authorities agreed to change the technical orders for the C-5 to enact conversion to the new grease in all grease lubricated aircraft applications.

"The consensus of Dover's maintenance operation specialists was that the conversion to MIL-PRF-32014 should occur as soon as possible," Ms. Gschwender said. "We also expect the grease to improve performance in other areas of the aircraft, and to replace many currently used military greases. This grease has demonstrated the potential to become 'near-universal.'" @